Responses of landslide frequency-area distributions to the magnitudes of driving forces

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Abstract

Landslide is a catastrophic disaster over the world, which leads to sediment-associated consequences such as debris flow, reservoir siltation, and etc. Landslide frequency-area relationship can be well estimated by the inverse-gamma distribution which consists of four parameters. Of which, ρ stands for the area of maximum frequency, *s* controls the distribution of small landslides, *m* and *a* are scaling factors regulating the magnitude and skewness of the distribution, However, the correlations between those parameters and corresponding driving forces have been rarely discussed. This study analyzed eight landslide maps occurring from 2001 to 2010 in the Gaoping watershed of Southern Taiwan, These landslides were all triggered by extreme rainfall events, i.e. typhoons. Typhoons with different characteristics, e.g. total rainfall amount and rainfall duration, resulted in varied landslide distributions which could be described by different parameters in the inverse-gamma distribution. It is found that fairly-good correlations exist between rainfall duration and the parameter ρ (r=-0.67), *m* (r=0.82), and *s* (r=-0.89). Parameter *a* ranged between 0.005-0.019 among all the landslide cases and did not much influence the inverse-gamma distribution. There were also good correlations between total rainfall amount and the parameter *m* (r=0.85), and *s* (r=-0.77). However, total rainfall amount seemed not a good proxy for the parameter $\boldsymbol{\rho}$ (r=-0.38). The results in this study reveal that the estimated parameters (derived from typhoon characteristics, particularly rainfall duration) might be applied to estimate even to predict landslide distribution if the forecasting rainfall characteristics are available.

Keywords: Typhoon, Total rainfall amount, Rainfall duration, Sediment